

Municipal Solid Waste Management System in Vadodara City: Current Scenario

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Abstract: Growing rate of population influences enhancement of municipal solid waste (MSW) generation. Municipal Solid Waste contains household and commercial refuse including paper, textiles, food and vegetable waste and wood and non-degradable materials; leather, plastics, rubbers, metals, glass and electronic waste. The current study reviews recent scenario of municipal solid waste system in Vadodara city, which revealed that solid waste system needs to be modified scientifically to manage non-biodegradable components. Solid waste samples of two seasons were collected from three dumping sites and landfill area in Vadodara, to determine non-biodegradable components of MSW. A comparison of ten-year old and daily waste, revealed polyethylene bags and food wrappers to be the major cause for plastic pollution. Much of municipal solid waste gets dumped in the open landfills, causing health risks to residents in their locality. This may cause a high risk of contamination of ground water/surface water, soil and air.

Keywords: Municipal Solid Waste, Waste Management system, Vadodara city

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I. Introduction

Solid waste generated by domestic, commercial and industrial activities is often disposed indiscriminately. In Vadodara as per survey conducted by Mehta and Pandey (2014) MSW collection is conducted in two stages. In first stage, the waste collected from door to door in small dumper is transported to dustbins and open dumps¹. In this stage, collection is not very efficient even though large numbers of private sweepers are engaged in waste collection from door to door at a nominal charge. Most residents drop the waste outside their residence, which in-turn is swept away by street sweeping and lifted by means of handcart or by rag pickers to the nearby open dumps. In second stage waste transported to the designated dumpsite by dumper/placer vehicle. Waste from open dumps is collected in trucks/tipper trucks/tractor manually or by JCB's and loaders and finally transported to the designated dumpsite. The bio-degradable waste is not segregated either at the primary collection points, secondary collection points, or dumping sites. Most of the bio-degradable waste are found to be eaten by animals at the grazing on the open dumping sites. Non-biodegradable wastes are disposed off at the dumping sites along with other wastes without any prior processing.

Former Environment Minister, Shri Prakash Javadekar, pointed out the issue of dumped waste that, out of 62 million tonnes of waste, only 43 million tonnes are collected annually and only 28% of it was treated, rest was dumped in landfills². Manual handling of solid waste during primary collection is an acceptable practice in the city. Safai Karamcharis involved in primary collection of MSW do not use any Personal Protection Equipment (PPEs) such as face masks, disposable gloves, boots, hats, and proper safety clothing (sturdy colored uniform) to avoid direct contact with waste and reduce the likelihood of on-the job injury.

In the present scenario waste management and handling process is unplanned due to lack of proper infrastructure, awareness among the public and its involvement. No target oriented awareness programs conducted in the past for solid waste management improvement or for waste segregation. A planned and concerted effort is required to bring about awareness among the public and make them realize their responsibilities as individuals and as a community. Public awareness, community contribution, transparent management, responsibility at all levels is the necessity of hour so as to ensure success of any MSW management plan. In the present study municipal solid waste at the different dumping sites have been analyzed to identify the different wastes generated & dumped by the common public.

II. Methodology

Collection and screening of Municipal solid waste from three temporary dumping sites and main landfill area (Figure.1 & 2) of Vadodara was conducted in two seasons i.e. summer and winter.

The main landfill area at Jambuva is somewhat oval shape and the dumped waste has reached approximately 20 ft. in height (Figure.5). Approximately 2 kg solid waste samples were collected from three different depths of each side as represented in Figure 2. For compositional analysis of municipal solid waste of Vadodara city, collected samples from all the three temporary dumping sites & landfill area has been categorized as showed in Table.1.

III. Result And Discussion

Active disposal Sites

In India approximated 50-90% of the million tonnes of solid waste is collected and dumped into uncontrolled open landfill sites³. Personal communication at Vadodara Municipal Corporation (VMC) office revealed that Vadodara city has three temporary active dumping sites for different zones; (i) In Karelibaug area for North zone, (ii) for east zone it is located in Waghodia, (iii) Atladara area for West & South zone and from all the three dumpsites, wastes are being transported to the large landfill site which is located at Jambuva, Vadodara (Revenue Survey No. 346). At the three temporary sites dumper carrying the waste is transported and segregated into recyclable wste. Thereafter the remaining waste is transported to the main landfill at Jambuva. Earlier Jambuva landfill had capacity of total 300 TPT waste and recently it is under maintenance for 750 TPT waste capacity. At the main landfill VMC has undertaken processing this waste in two ways; Biomethanation which produces compost & Biogas and plastic waste is being processed to produce Biodiesel, presently both the processes seemed to be inactive during the visit. Jambuva landfill cell has 45000 sq.mt. area and it has 4 lac M.T. waste capacity. The area is covered with 1.5 mm thick H.D.P.E liner to protect landfill soil from dumped waste.

According to Central Pollution Control Board (CPCB), average collection coverage of solid waste ranges from 50%-90% and 94% of all collected waste is disposed of in an unacceptable manner. Hence it leads to contamination of groundwater and surface water through leachate⁴. Vadodara city has similar scenario of waste management, as shown in Figure.5 (C) daily waste is simply given to cattle to be eaten which is completely objectionable manner of daily waste disposal. At Jambuva landfill area leachate collection system had been developed by using 100 mm thick perforated H.D.P.E. lateral pipe, but VMC doesn't perform any further process for collected leachate. Many regulated landfills attempt to utilize landfill biogas, a renewable energy source, to generate electricity or heat, but no such practice observed in VMC waste management.

Collection and Physical Characterization of Solid waste

Near VUDA Bhawan (Karelibaug) dumping site segregation of recyclable waste is being conducted by rag-pickers. Further these segregated recyclable waste such as glass bulbs & bottles, milk bags, used plastic bottles (Cosmetics & Soap) (Figure.5.) are being supplied to scrap dealers. At Atladara and Waghodia dumping sites no such segregation process is being conducted. The daily waste including all kind of wastes is being given to cattle to be eaten at Atladara dumpsite, while Gadheda market dumpsite is simply used as a transit for transferring daily waste to main landfill area. Physical characteristics of the solid waste collected and analyzed from the different dumping sited of Vadodara has been represented in Table.1-3.

Table.1. indicates approximately 80% of wastes have either ability to be recycled or to be degraded naturally in the environment, rest 20% is causing damage to our ecosystems while ingested by mammals and also considered to be non-biodegradable. In this analysis highest percentage is of kitchen waste which is either eaten by cattle or degraded naturally in few months.

Table.1. Physical characteristics of daily Solid waste from temporary dumping sites

Sr. No.	Nature of Waste	Percentage (%)		
		Site 1 (VUDA Bhawan)	Site 2 (Atladara)	Site 3 (Gadheda Market)
1	Kitchen waste (Rotten fruits & Vegetables, peels of vegetable & Fruits etc.)	53	67.7	59.5
2	Glass (Bottles/ Bulbs)	10.9	-	5
3	Packaging waste			
	(i) Paper Boxes	6	4	-
	(ii) Food wrappers, Plastic bags of milk & other products	15.55	14.7	3.1
	(iii) Soap Bottles	3.3	1.5	-
4	Paper waste	3.6	1	7.6
6	Polyethylene Shopping bags	4.85	8	14
7	Disposable waste	2.25	2.05	3.15
8	Dried leaves & branches	-	-	1.2
9	Unclassified debris, soil	4.45	1.75	6.5

Atladara dumping site has two locations in which one is for daily waste and other location has more than ten years old waste. Comparison of daily waste samples and ten-year old sample shows that kitchen waste, paper & box waste get degraded by microorganisms in a period of few months. Soap bottles, milk packaging bags & glass wastes are being recycled. As shown in Table.2. & Figure.3. remaining wastes like polyethylene bags and plastic food wrappers are highest in percentage in ten-years old waste samples, thus such waste is required to be managed scientifically.

Table.2. Physical characterization of solid waste from Atladara dumpsite (Ten- year old)

Sr. No.	Nature of waste	Percentage (%)
1	Polyethylene Bags	31.86
2	Packaging waste (Food Wrappers)	27.45
3	Coir	6.86
4	Textile waste (Leather, Fabric)	22
5	Disposable waste	3.43
6	Unclassified debris & Soil	8.33

Solid waste samples collected from Jambuva landfill area showed different composition in each depths. Solid waste sample from 0 ft. had highest content of soil & unclassified debris and lowest in 20 ft. waste sample that explains decomposition of degradable waste. Kitchen waste was only found in 20 ft. waste samples i.e. 24.44% of total waste sample. Textile waste was observed in all three depths samples. Plastic waste includes different kind of plastic products such as food wrappers, plastic bags of milk & other products, soap bottles & cosmetic packaging waste, disposable utensils and polyethylene bags. In this analysis it reveals that approximately 25% of plastic waste is present in municipal solid waste. Among these all plastic waste products highest percentage was of polyethylene bags. (Table.3.) (Figure.4.) No significant difference was noted in the composition of waste when two different seasonal waste sample were compared. As per review article given by Sharholy *et al.*, 2008 MSW from metro cities of India contain about 3.9% of plastic waste while in this study both the seasons MSW contains approximately 26% of plastic waste materials which are causing damage to our ecosystems⁵. Plastic materials widely used and contributing to plastic waste are polyethylene shopping bags and plastic water bottles.

Table.3. Physical characteristics of Municipal Solid waste from Jambuva landfill Area

Sr. No.	Nature of waste	Percentage (%)		
		0 Ft.	10 Ft.	20 Ft.
1	Rubber waste	0	30.47	0
2	Kitchen waste (Rotten fruits & Vegetables, dried vegetable skins)/ coconut outer layer	0	0	24.44
3	Glass (Bottles/ Bulbs)	0	6.59	0
4	Fabric/ Leather	11.94	21.39	6.03
5	Paper Boxes	1.16	1.49	6.15
6	Food wrappers, Plastic bags of milk & other products	9.04	6.71	6.84
7	Soap Bottles/ cosmetic tubes	0.80	0	0
8	Thermocol Packaging waste	0.68	0	4.04
9	Polyethylene Shopping bags	10.19	12.56	16.23
10	Disposable waste	4.47	2.48	2.05
11	Tooth brush/pen/ comb/CDs/ bottle cap/ toys	1.36	0.87	0.31
12	Dried leaves & branches	2.17	40.29	19.15
13	Unclassified debris, soil/ rocks	58.14	26.74	15.48

IV. Conclusion

This research study on MSW management of Vadodara city brings attention to non-biodegradable plastics i.e. polyethylene bags and food wrappers. PET bottles and other packing plastic wastes get segregated and recycled but only remaining plastic waste should be managed scientifically at the landfill area. Studies are being carried out in the laboratory to successfully biodegrade polyethylene plastics without be composition and being toxic to environment. Plastics are of different composition and can be categorized into Polyurethane, Polyethylene terephthalate, Polyethylene, Polyvinyl Chloride, Polypropylene & Polystyrene used for production of different products used in our daily life. The present research study reveals that polyethylene plastics are the main waste which needs an urgent attention. Degradation of polyethylene plastic products is of great

importance. Public awareness required to be carried out to reveals the toxicity which prevails due to the use of the plastics.

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Figure.1. Map showing the study area including three temporary dumpsites and a main landfill area



Figure.2. Sample collection methodology of Jambua landfill area

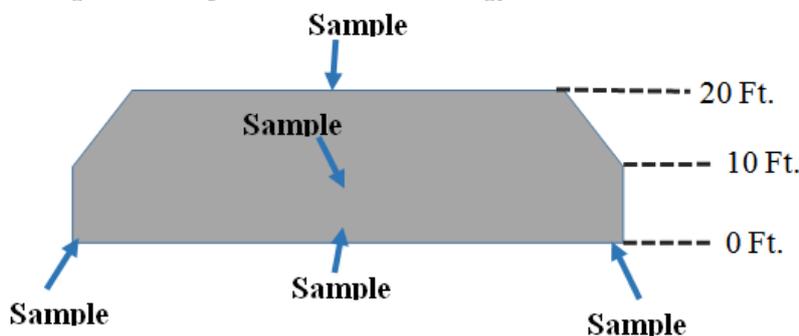


Figure.3. Comparison of daily waste (temporary dumping sites) and 10-years old waste samples (Atladara dumping sites)

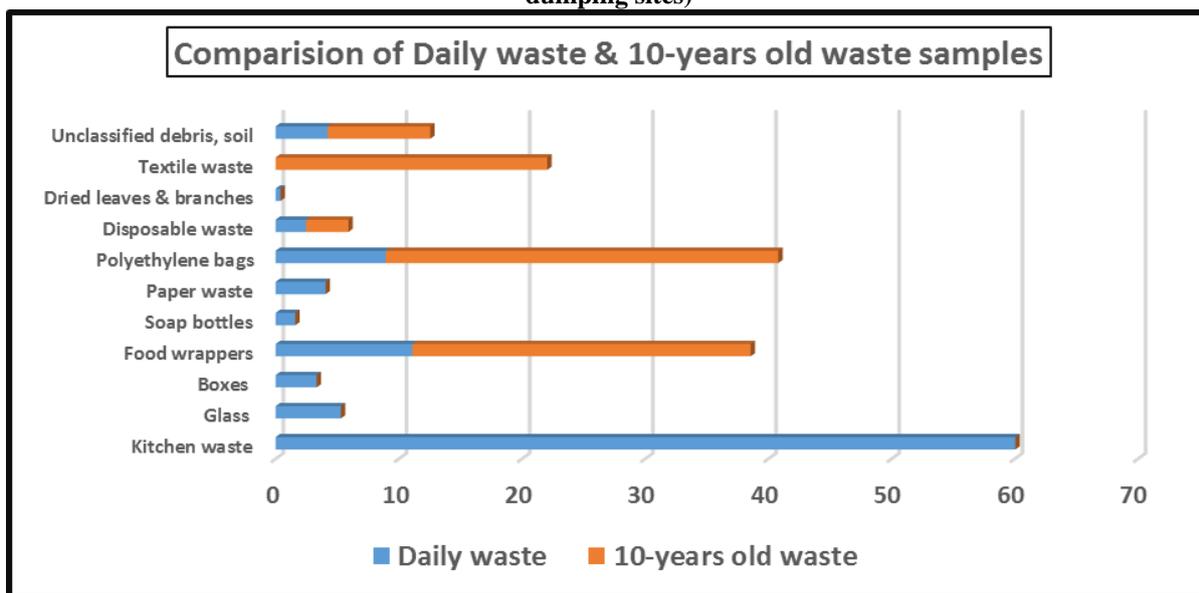


Figure.4. Comparison of Jambuva landfill waste samples from three different depths

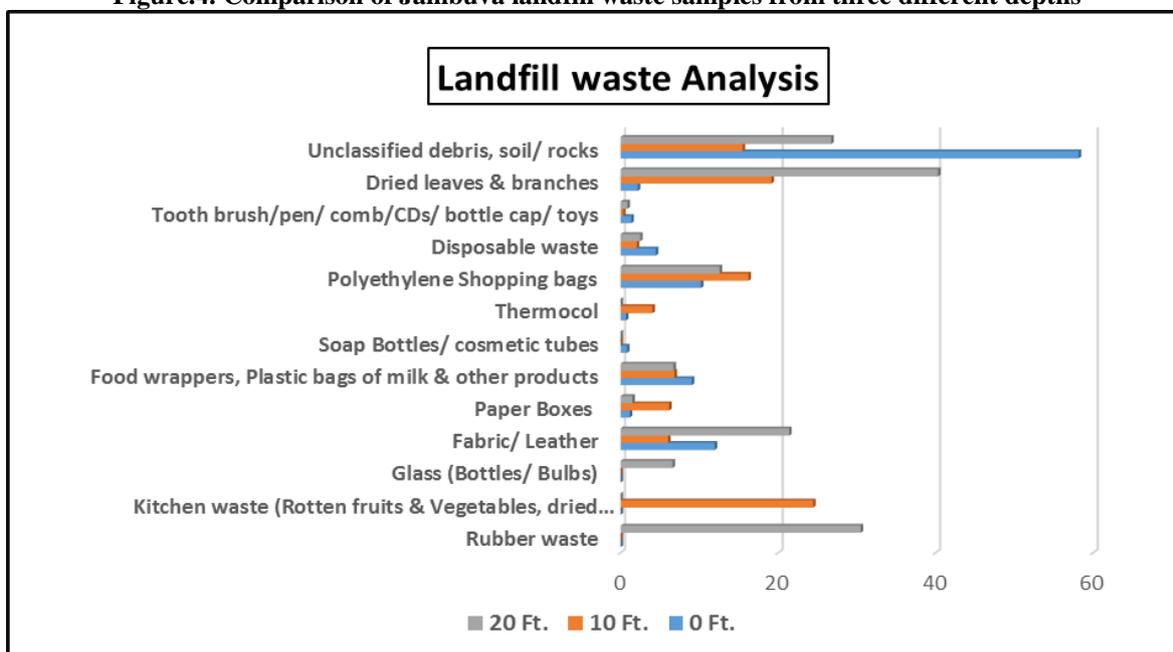


Figure.5 A-F: Temporary Dumping sites of Vadodara City (A- Karelibaug area; B- Waghodia area; C- Atladara area; D- Atladara dumpsite with ten-year old waste; E & F- Segregation of recyclable waste)
G-I- Old dumpsite converted .into garden at Atladara area
J-L- Jambuva Landfill area (J & K- Waste Disposal; L- Leachate separation)



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